EFFECT OF KNOWLEDGE RETENTION INSTRUCTIONAL STRATEGIES (KRIS) ON CRITICAL THINKING, LONG - TERM MEMORY AND ACADEMIC PERFORMANCE OF SECONDARY STUDENTS

Synopsis

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1.0.0Introduction

Education plays a pivotal role in social and economic transformation of the nation. Qualitative education is the need of the hour, then expansion of educational facilities and infrastructure in educational institutions. Lack of quality in education may result in various inefficiencies in the students learning, hence for qualitative improvement both cognitive and non-cognitive competences are required. This transforms the child from a person who memorizes mechanically for knowledge acquisition to a person who can retain the acquired knowledge for a longer period of time, thus changing the student cognition from a level of short-term memory to long term memory which can transmit this knowledge for personal, communal, social and national benefits. India with more than 260 million enrolled students in various Institutions is facing many ongoing challenges in the field of education. The Indian schooling system is one of the largest in the world and caters to over 250 million students. Many educational commissions after Independence strived a lot to improve the enrolment and access to education. Along with many government initiatives (SSA, EFA, NIOS, NVS) right to education act focusing on the issues of gender disparity, inclusivity and quality in education.

NEP 2020 observed major evils of rote learning which is to be eliminated on an urgent basis, this method of regular reptation known as rote memory blocks the creative minds of the students and results in short term memory which decreases day by day. Knowledge gained by the students from rote memory will not be retained for a longer period of time.

Knowledge retention means grasping or capturing information from the teaching learning environment which can be stored/ memorized in such a way to be used later. Knowledge retention strategy can be used after identifying the resources of knowledge that are at risk and include those strategies to increase attention, critical thinking and reasoning which transforms the acquired knowledge to a long-term memory. Better memory and retention mean better learning, and this can be the resultant of new innovative, interactional, creative and reflective instructional strategies. Cone of learning developed by the national training laboratory suggests that kinesthetics methods of learning like discussions, practice doing, and teaching others lead to more retention and deep learning developing a holistic personality Development of the Individuals, It also a permanent record of all our emotions and long-term memory (LTM) is the permanent, accumulation of all the information,

knowledge, and understanding we have learned across a lifetime. experience of a lifetime. When all these external and internal stimuli is processed into long term memory (LTM). It creates permanent changes in the neurochemistry, protein and across many brains region where the memory traces are stored (like a grain of salt dissolved in the ocean, memory becomes part of a complex composite.)

2.0.0 Emergence of the problem

To reduce the gaps between urban-rural achievement and thinking process, NEP (1986) suggested Navodaya Vidyalaya's, central schools, core curriculum and continuous comprehensive evaluation and grading system. The NEP (2020) also recognizes the importance of core capacities as an important issue to be taken up to shift the students from rote memorization skills to analyses and classify concepts with more understanding and critical thinking with a reflection of scholastic or co-scholastic and affective outcomes. A deeper understanding and application of concepts is essential to secondary students for their holistic development than a simple rote memory.

A survey of quality education by VIPRO (2011) revealed that students are not at all using their minds for analytical thinking to develop their abilities. Students are simply memorizing large syllabi without any application of that knowledge to real life situations. This makes the students acquire the knowledge by hook or crook, but they are not able to retain that knowledge to empower their left and right brain. Both the hemispheres of the brain can enhance neural attention, critical thinking, logical reasoning, imagination, creativity etc. but to enhance them some innovative, instructional strategies, simulation training, multiple sensory strategies, storytelling, bite sized learning, active participation are essential for knowledge retention.

Present teaching learning environment is promoting rote learning which is shattering the doors of cognitive capabilities of students especially in the covid era applying multimedia technology. Retention of the acquired knowledge should be stored in our brains as long-term memory. Strategies of knowledge retention promote students to be academically good with an enhancement of critical thinking, Logical reasoning, visual attention, and creativity. This occurs when students use both brains i.e., left and right brain which ultimately leads to storing knowledge in long term memory in hypothalamus. Left brain uses are good at logical, critical thinking, whereas right brain uses are emotional and sensitive in nature and they are good at visualization, Fine arts and creativity. Even though every child has an inherent

capability to use their left and right brains mostly, our new teaching learning system (Pedagogies, Techniques, Evaluation, Strategies) should try to develop the capabilities of both brains of students to develop and integrated personality with logical reasoning, critical thinking, imagination, creativity, attention and Scientific Attitude.

Quality concerns are always at priority as suggested by many polices and committees of education and they recommended a change in the style of teaching including reformative instructional strategies to bring about desired learning out comes and an integrated personality development of students.

In the present study researcher wants to identify the problems or issues faced by the students in their academic performance and develop critical thinking and reasoning in the concepts taught by the teachers. To find out answers to the questions aroused in the mind of the researcher such as which method of teaching activate the brain of students to enhance their academic performance? Which brain-based learning strategies promote knowledge retention in the brains of secondary students?

Are there any brain-based learning strategies to transfer students' ability from knowledge acquisition to knowledge retention?

How to improve critical thinking among secondary students while studying science subject? Are there any instructional strategies to retain knowledge for longer period of time?

How strategies of knowledge retention effect the critical thinking and performance of students?

Many researchers **Muller et al. (2006), Kamat (2009), Mayer (2009)** highlighted the new technologies of teaching to improve the knowledge and understanding of students. Studies of **Woolnough(1994), Zoller (1993)** and **Fredman (1997)** revealed a correlation between quality of instruction and quality of science and a conducive classroom environment with brain based instructional strategies plays a major role in the knowledge retention of students.

To find out answer for the above question the researcher decided to do research on the topic of effect of knowledge retention instructional strategies (KRIS) on critical thinking, long-term memory and academic performance of secondary students. And few studies mentioned below which show the importance and need of this research.

Kara izzat (2008) The aim of this research is to determine the retention effect of computer assisted instruction (CAI) on students' academic achievement for teaching the physics topics. In this research,

132 students were structured as both control and experiment groups. the science subject test was applied to both groups. Significant differences between the science subject test scores of experiments and control group were found in favor of experiment group.

Stanchev (2008) In this paper he reported his experience with the two approaches and explore the idea of combining them. In particular, he argued that diversifying the avenues in which students are exposed to knowledge in a technical discipline, such as computer science, can spark their enthusiasm and make the learning experience more enjoyable and productive.

Ozden (2008) The aim of this study is to investigate the effects of brain-based learning in a 5th grade science course on academic achievement and retention of previously acquired knowledge. This experimental study, which was designed as pre- and post-test control group model, was conducted in 2004-2005 academic year at kütahya Abdurrahman paşa primary school in kütahya, turkey. During the research process, the experimental group was administered a brain-based learning approach, while the control group was administered a traditional teaching approach. Analysis of post- test and retention level tests revealed a significant difference between the groups favoring brain- based learning.

Duman, B. (2010) The purpose of the present study is to investigate the effects of brain-based learning (BBL) on the academic achievement of students with different learning styles. The study group consists of students from the department of social sciences Teacher education in the faculty of education at mugla university (N=68). the findings of the study revealed that the BBL approach used in the experimental group was more effective in increasing student achievement than the traditional approach used in the control group. However, no significant difference was observed among the achievement levels of the experimental group students with different learning styles.

Konecki, L. R. & Schiller, E. (2003) This paper explains how brain-based learning has become an area of interest to elementary school science teachers, focusing on the possible relationships between, and implications of research on brain-based learning to the teaching of science education standards. The paper described three implications from current brain research 1. stress limits of children. 2.doing activities that has immediate connection. 3.to maintain learning and dendrites connection. The brain needs to have concepts revisited in several different ways to encourage the active processing needed to keep connections and foster memory.

Michael W. Eysenck, Mark T. Keane (2015) Long-term memory systems they mentioned that there are several memory systems is very influential. This paper discusses the various forms of declarative and non-declarative memory. Declarative memory is divided into semantic and episodic/autobiographical memory, whereas non-declarative memory is divided into priming and skill learning or procedural memory.

Howe, M. L., & Brainerd, C. J. (1989) In this article, he reviewed extant research on children's amnesia and hypermnesia. As the review unfolds, a number of methodological and measurement problems are examined, and a new theoretical framework is presented that is implemented in a mathematical model. We show how application of this framework eliminates the indicated problems.

Furman, O., Dorfman, N., Hasson, U., Davachi, L., & Dudai, Y. (2007). They measured long- term memory for a narrative film. During the study session, participants watched a 27-min movie episode, without instructions to remember it. Analysis of different content elements in the movie revealed differential memory performance profiles according to time since encoding. We also used the data to propose lower limits on the capacity of long-term memory. This experimental paradigm is useful not only for the analysis of behavioral performance that results from encoding episodes in a continuous real-life-like situation, but is also suitable for studying brain substrates and processes of real-life memory using functional brain imaging.

Ennis, R. H. (1962) Construing critical thinking as "the correct assessing of statements," 12 overlapping characteristics of the critical thinker are presented along with appropriate lists of criteria. A logical analysis of the 12 abilities is made along 3 dimensions: logical, critical, and pragmatic. Possible research steps for the evaluation and teaching of critical thinking are suggested.

King, A. (1995) Inquiring minds really do want to know: Using questioning to teach critical thinking. Researcher Presented an inquiry-based approach to promoting critical thinking in psychology based on autonomous learning by students. The model includes cooperative learning applications, such as reciprocal peer questioning, while serving a metacognitive role. Research results and theoretical bases for effectiveness are presented.

This study aims to describe the development of augmented reality-based interactive multimedia to improve the critical thinking skills of elementary school teacher education students in learning earth

structure and fisheries material science. The results of the study show that the development of media products determines indicators of learning, programming, display, and curriculum.it can be decided that H0 rejected. Students think critically using augmented reality-based interactive multimedia better than before using it. At present, it is obtained interactive multimedia based on augmented reality that is feasible to use in accordance with the views of experts and users.

Syawaludin, A & Rintayati, P. (2019) Elementary school students' critical thinking skills in mathematics education are part of 21st-century learning competencies as stated in the Basic Education Core Curriculum B.E 2551 in Thailand. The study aims to investigate the Elementary School Students' Problem Critical Thinking Skills in mathematics learning in Thailand.

Lelin (2019) This study explained critical thinking skills in education processes and the importance of thinking critically for a student who attends any education programmed. Developing the ability to think critically is an important element for modern education approaches and models. This study intends to give a framework on the concept of thinking critically while teaching or learning. The skill of thinking critically is generally accepted as a very vital stage in every field of learning, particularly in the last decades. As a study draws a general suggestion on the importance of critical thinking skills.

Shields, G. S, Sazma, M. A., McCullough, A. M., & Yonelinas, A. P. (2017) The effects of acute stress on episodic memory: A meta-analysis and integrative review. A growing body of research has indicated that acute stress can critically impact memory. These analyses indicate that stress disrupts some episodic memory processes while enhancing others, and that the effects of stress are modulated by a number of critical factors. These results provide important constraints on current theories of stress and memory, and point to new questions for future research.

According to **Paul and Elder (2006)** these two concepts cannot be separated, and in fact, they should be viewed as different aspects of thinking. Creativity involves creating something new or original and critical thinking involves logic and reasoning. Creativity is related to right hemisphere of the brain whereas critical thinking (CT) is mainly related to the left part.

According Andrews (1996) The instructor plays an important role in cultivating critical thinking skills, as well as serving as the domain-specific content expert. Effective teachers facilitate student critical thinking skill development when they implement learning activities that have authentic, real- world

contexts and personal relevance to the student.

Strohm & Baukus (1995) To enhance critical thinking in classrooms, advocate to produce much ambiguity in the classroom. They suggest not to give students clear cut material. Instead, give them conflicting information that they must think their way through.

Elder and Paul (2010) identified the following advantages of Critical thinking If students (in general) possess strong CT skills then they: learn content at a deeper and more permanent level 1.are better able to explain and apply what they learn, 2.are better able to connect what they are learning in one class with what they are learning in other classes, 3.ask more and better questions in class, 4.understand the textbook better, 5.follow directions better,6.understand more of what you present in class,7. write better, 8.apply more of what they are learning to their everyday life,9.become more motivated learners in general,10.become progressively easier to teach.

Anthony V D'Antoni et al (2010) tried to find out whether the mind map learning strategy facilitate information retrieval and critical thinking in medical students and revealed that although mind mapping was not found to increase short-term recall of domain-based information or critical thinking compared to 'Standard note taking', a brief introduction to mind mapping allowed novice Mind Mapping subjects to perform similarly to 'Standard note taking' subjects.

According to Paul and Elder (2007) while Creativity masters is a process of making or producing, CT is a process of assessing or judging. Although there is a difference between creativity and critical thinking, but a good thinking process requires both. A conceptual framework 73 critical thinker gathers, analyzes, examines, and evaluates information; a critical thinker can also distinguish between opinion and fact.

Maknun, J. (2020) This research aims to implement the guided inquiry learning model to improve the understanding of concepts and critical thinking skills of vocational high school (SMK) students. The result showed that the implementation of guided inquiry learning models has the ability to significantly improve the understanding of static fluid concepts and critical thinking skills of vocational high school students compared to conventional learning. This was because it provided the opportunity for students to independently construct a concept through problem presentation, formulation of hypotheses, data collection, analysis, and conclusions.

3.0.0 Justification of the Problem

Secondary education is a vital link between primary and higher education, and it acts as a bridge to bring about behavioural change in the persona of students by developing logic, reasoning and critical thinking. This bridge is becoming fragile due to a lack of quality, excellence and systematic organization by the content knowledge to facilitate retention of knowledge rather than knowledge acquisition gained by rote memory.

Many researcher, report ASER (2000)and National Curriculum Frame work (2005) emphasized upon the development of quality of education , especially in subject of science and mathematics to prepare the students role stable to withstand the stress and strain of adolescences period and achieve the goal of education according to their aspiration innovative and interactive instructional strategies facilitate a learner to be self- sufficient, confident, knowledge, intelligent, independent and reasonable activity based instructional strategies make a learner critically analytical, creative and intelligent to transfer the knowledge acquired through teaching in to knowledge retention.

National policy of education 2020 the burden some curriculum will be reduced to provide a space to critical thinking, analytical thinking, discovery, enquiry and holistic learning strategies of knowledge retention will help the students to improve their academic performance through competency, based learning practiced a group in co-operative learning. New Policy 2020 emphasizes on hands on experiences and experiential learning and diminish rote memorization. Competency leaning should be promoted to solve problems and develop creativity for an integrated personality development. These strategies transfer students' behaviour from rote memorization to knowledge retention involving brain-based activities to promote learning involving left brain and right brain.

Those brain-based learning strategies which help students to enhance their academic performance and transfer their knowledge from acquisition to retention are considered as knowledge instructional retention strategies (KRIS).

Thus, enhancement of creativity, critical thinking, logic, analytical skills which increase the academic performance of secondary students. NCF 2005 suggested that more emphasis should be laid on science teaching to abilities to develop students to imbibe attitude towards life -long learning.

The ASER Report 2019 emphasized on development of 4A's Activity, Abilities, Awareness,

Aspirations. These 4As turn up the students face the challenges of real-life situations and transfer their knowledge from a short-term memory to long term memory with the help of recall, recognition, emotion, and values. To promote critical thinking, long-term memory, and academic performance of secondary students the researcher selected to study the effect of upon critical thinking, long-term memory, and academic performance of secondary students.

4.0.0 Significance of the Study

The present study has greater importance in the field of teaching learning process in every school. The purpose of the study is to enlighten the instructional strategies which give additional enhancement in knowledge retention of students. Dzuiban and coolegues (2004) explain that the instructional model of entire course is to be reconceptualized and redesigned, retaining the face- to-face component, yet shifting "from lecture to student-centered instruction in which students become active and inactive learners." Learning is the relatively permanent change in behaviour due to practice and experience. In keeping the practice and experience in mind researcher involves the students centered knowledge retention instructional strategies. human minds possess special ability by virtue of which every experience or learning leaves behind memory images or traces that are conserved in memory.

This preservation of the memory traces by central nervous system or brain is known as retaining of the learned or experienced act mangal S.K(2007). In the present study the knowledge retention will be confined the performance of learner on academic and critical thinking of learner. The amount of knowledge retention will be directly affected by the degree of active learning. If the learner did not learn the material well initially, they will not retain it well. Retention by learner is directly affected by their amount of practice during learning. Instructor should emphasize on knowledge retention instructional strategies (KRIS)and application. activity and brain-based learning is demand of the education and learner as well. As ASER Report 2019 mentioned the core four as (Activity, Abilities, Awareness, Aspirations.) which help the learner to transforms the knowledge short term memory to long term memory with the help of recall, recognition, emotion, and value. The knowledge retention instructional strategies (KRIS) transfer the student behaviour and critical thinking from rote learning to activity and brain-based learning.

These strategies transfer students' behaviour from rote memorization to knowledge retention involving

brain-based activities to promote learning involving left brain and right brain. National policy of education 2020 mentioned the need of critical thinking, analytical, logical thinking etc. improves the student's academic performance and competency-based learning. Strategies of knowledge retention promote students to be academically good with an enhancement of critical thinking, logical reasoning, etc.

The knowledge retention instructional strategies (KRIS) play a vital role in teaching learning process and enrich the quality of learning for future generation.

5.0.0 Statement of the Problem

The topic selected for research is followed:

"Effect of Knowledge Retention Instructional Strategies (KRIS) on Critical Thinking, Long-term Memory and Academic Performance of Secondary Students."

6.0.0 Operational Definitions of the terms employed in the Study

The various terms used in the statement of the problem have different connotation for various people. To make this more meaningful in the present context. The operational definitions are given below:

6.1.0 Knowledge Retention

Knowledge Retention is the process by which new information is transferred from short term memory to long term memory. Anne Watkins (2019)

Knowledge Retention is that knowledge which is retained for a long period in long term memory with an improvement of critical thinking and academic performance of secondary students.

6.2.0 Instructional Strategies:

Instructional strategies are instructor methods that include specialized instructional phase in line with the particular purpose of the subject and the features of the content area so that learners can gain target behaviour. Silver et al. (1996)

Instructional strategies are the strategies applied in the subject of science to retain the knowledge acquired by the student for a long time to foster the long-term memory of secondary students.

6.3.0 Knowledge Retention Instructional Strategies (KRIS)

Knowledge retention instructional strategies are those strategies which promote the Critical Thinking

and Academic Performance of Secondary Students to retain the Knowledge Acquired in subject for a longer period of time transferring short term Memory to long term Memory.

6.4.0 Critical Thinking

Critical Thinking is the intellectually disciplined process of actively and skillfully, conceptualizing, applying, analyzing, synthesizing and evaluating information gathered from or generated by observation, experiences reflection, reasoning, or communication. (National Council for Excellence in Critical Thinking)

Critical thinking is an active process of retaining information gathered through instructional strategies to enhance the skills and reasoning of the content taught to the learners.

6.4.0 Long-term Memory

Long-term memory is conceptually, the process by which event, skills, procedures, and concepts are stored indefinitely in the mind. That is not to say that forgetting is impossible, just that there is no precisely defined point when that will happen.(Greene1987)

Long-term memory helps to retain the information for a longer period of time, month, year or entire life, which recalls the concepts according to the situation to enhance the past knowledge about event, content, process, and program by transferring short-term memory to long-term memory.

6.5.0 Academic Performance

Academic performance deals with students‟ performance in different subjects in a standardized series of educational tests. International Dictionary of Education, (1999)

Academic performance is getting knowledge in the subject of science to gain mastery of the content taught through instructional Strategies.

6.6.0 Secondary Students

Secondary students belong to an age group which act as a bridge between primary and higher secondary education.

Secondary student are those students studying from class VI to X from the age of 11to 15 year.

7.0.0 Objectives of the Study

The objectives of the present are research study are laid down by the researcher as:

1. To construct lesson plans applying knowledge retention instructional strategies (KRIS) after

pretest to analyze the effect of KRIS on Critical thinking, Long -term memory and Academic performance of Secondary Students.

2. To determine the effect of knowledge retention instructional strategies (KRIS) on Critical thinking of secondary students.

3. To analyze the effect of knowledge retention instructional strategies (KRIS) on long-term memory of secondary students.

4. To infer the effect of knowledge retention instructional strategies (KRIS) on academic performance of secondary students.

8.0.0 Hypotheses of the Study

For fulfilling the above-mentioned objectives of the study, the researcher formulated the alternative hypothesis as under:

Ha1: There will be a significant effect of knowledge retention instructional strategies (KRIS) on critical thinking of secondary students.

Ha2: There will be significant effect of knowledge retention instructional strategies (KRIS) on long-term memory of secondary students.

Ha3: There will be a significant effect of knowledge retention instructional strategies (KRIS) on academic performance of secondary students.

9.0.0 Variables of the Study: The variables of Study categorized as follows.

1. **Independent Variable**: In the Present investigation Knowledge Retention Instructional Strategy (KRIS) are the independent variables of the study of research.

2. **Dependent Variables**: In the Present Investigation Critical Thinking, Long-term Memory and Academic Performance are selected as dependent variables of the study.

3. **Controlled/Extraneous Variables**: Class, Age, Content, Time Schedule during Teaching etc.

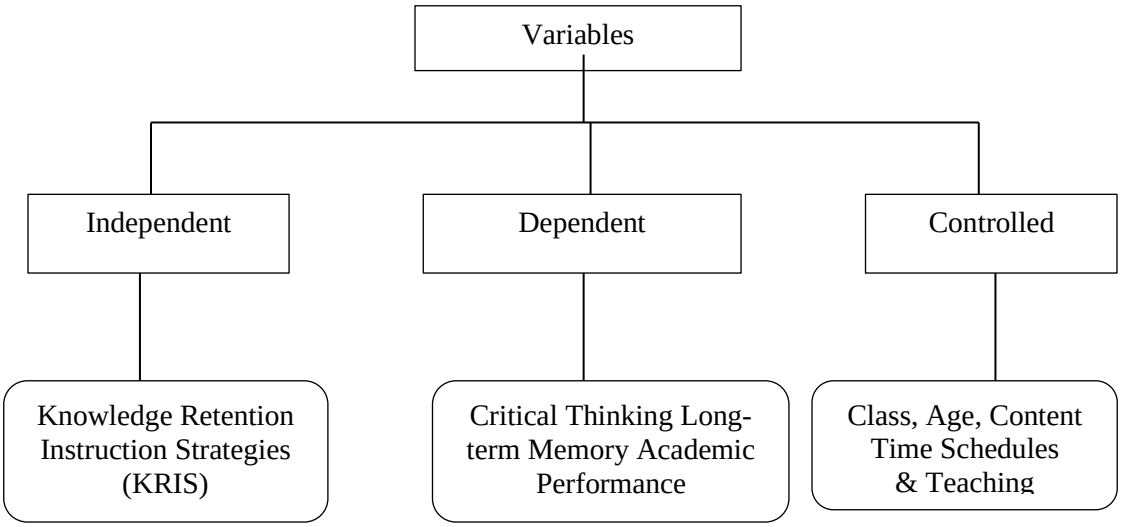

Fig. 1: Variables of the Study

10.0.0 Procedure of the study

In the present study researcher will apply quasi-experimental method of research by taking a two- group control and experimental design by teaching with traditional method to the control group whereas applying knowledge retention instructional strategies while teaching to the experimental group for a period of 60 days. The intervention will be done in the subject of science for 60 days to infer the effect of knowledge retention instructional strategies (KRIS) On the critical thinking, long term memory and Academic performance of secondary students. The intervention will be done on 80 students (40 control and 40 experimental) to the students of class IX.

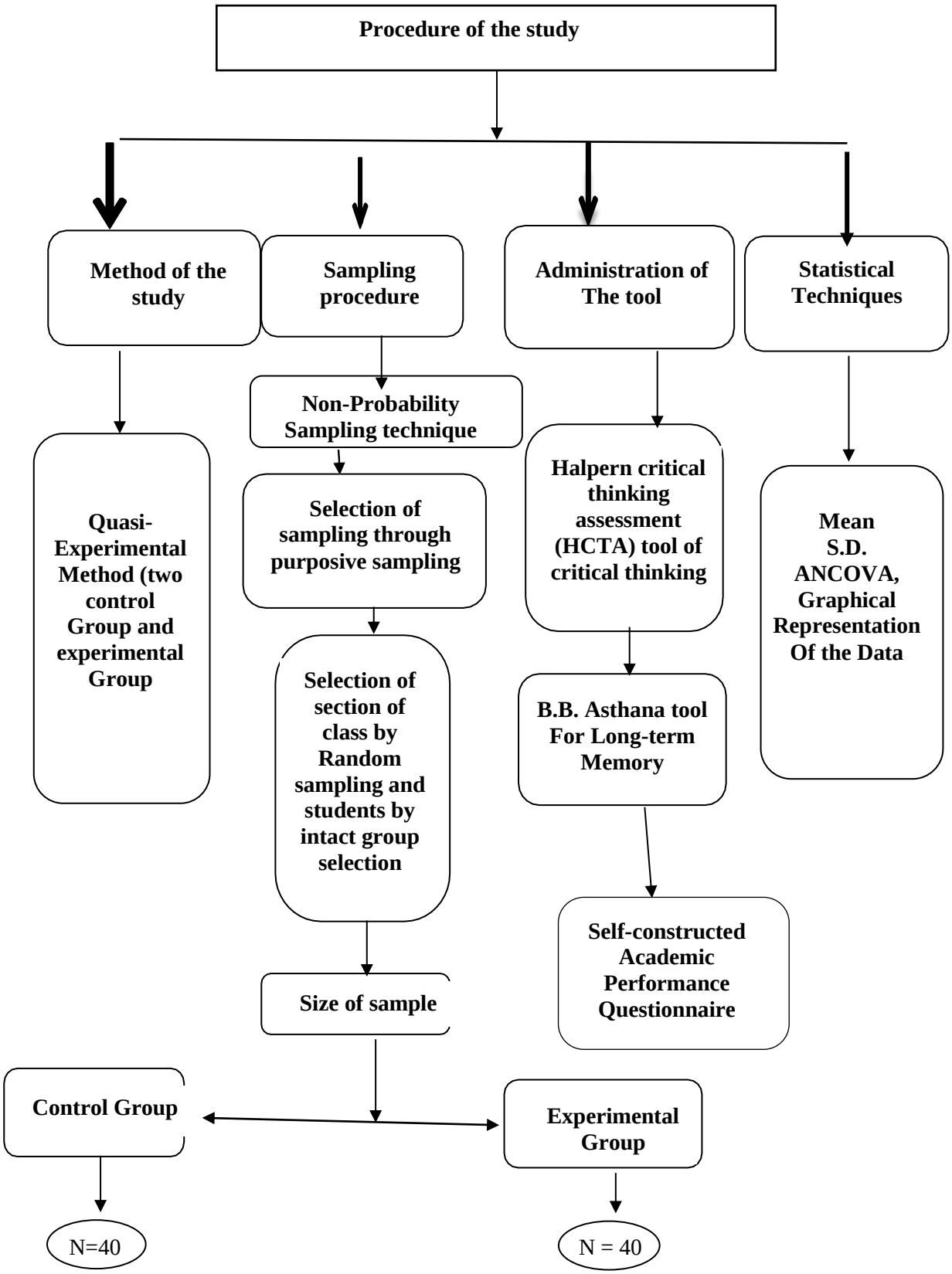
Procedure of the study
Method of the study
Sampling procedure
Administration of The tool
Statistical Techniques
Quasi-Experimental Method (two control Group and experimental Group
Non-Probability Sampling technique
Selection of sampling through purposive sampling
Selection of section of class by Random sampling and students by intact group selection
Size of sample
Control Group
Experimental Group
N=40
N = 40
Halpern critical thinking assessment (HCTA) tool of critical thinking
B.B. Asthana tool For Long-term Memory
Self-constructed Academic Performance Questionnaire
Mean
S.D.
ANCOVA,
Graphical Representation Of the Data

Fig. 2: Procedure of the Study

11.0.0 Design of the Study

Research method is the most important step which provides pathway to other components for carrying out the research process further. Selection of Research method depends upon the objectives of study, variables taken into consideration subjects for whom study will be conducting and the condition under which research is carried on. Researcher will be using Two-Group Quasi-Experimental Design to know the effect of Critical Thinking, Long-term Memory, and Academic Performance of IX class Students.

12.0.0 Process of the Study

Before Intervention, a Pre-test of Critical Thinking, Long-term Memory, and Academic Performance will be administered on Control Group (40 Girls Students) and Experimental Group (40 Girls Students) and after completing the Intervention for 60 working days the post-test will be administered on the same dependent variables and to know the effect of Knowledge Retention Instructional Strategies (KRIS).

Table No. 1: Design of Study

Group	Pre-Test	Treatment	Post-Test
Control Group (40 Girls Students)	Critical Thinking, Long-term memory, and Academic Performance	Teaching of Science by using Traditional Approach (One Period per day for 60 days)	Critical Thinking, Long-term memory, and Academic Performance
Experimental Group (40 Girls Students)	Critical Thinking, Long-term memory, and Academic Performance	Teaching through Knowledge Retention Instructional Strategies in Science. (One Period per day for 60 days)	Critical Thinking, Long-term memory, and Academic Performance

13.0.0 Tools and techniques for data collection

The following tools and techniques will be selected and applied during data collection before and after implementation if interventions

Table No. 2: Tools and techniques for data collection

S.N.	Variables	Name of Tools and Techniques	Years	Authors
1.	IV (Independent Variables)	Knowledge Retention Instructional Strategies applied through self-constructed activity-based lesson plans		
2.	DV (Depended variable) Critical Thinking	1.Cornell Critical Thinking Test (CCTT) 2.California Critical Thinking Skills Test (CCTST) 3.Halpern Critical Thinking Assessment (HCTS)	1985 1990 2010	Ennis, Millman Facione Halpern
3	DV (Depended	Human Memory and experimental Procedure on Long Term Memory (LTM)		B.B. Asthana

	variable) long-term memory	and Short-Term Memory (STM)		
4.	DV (Depended variable) Academic Performance	Self- Constructed Tool	-	-

14.0.0 Selection of the Sample Unit

Table No. 3 Selection of Sample Unit

Level of Students	Secondary Level
Class	IX
Age	14-16
Stream	Science
School	Prem Vidyalaya Girls Intermediate College

15.0.0 Statistical Techniques

Mean, Standard Deviation, ANCOVA, Graphical representation, and Inferential Statistics will be applied to know the Significance of the effect of knowledge retention instructional strategies (KRIS) on critical thinking, long-term memory, and academic performance of secondary students.

16.0.0 Delimitations of the Study

The Study is delimited in the following ways:

1. The Study will be conducted in Agra city only.
2. The Present study will be limited to students of IX class enrolled in secondary students of Agra city.
3. The study will be confined to the subject of science only.
4. The study will be conducted on girl's students

Bibliography

1. Agarwal, N. K., & Islam, M. A. (2015). Knowledge retention and transfer: how libraries manage employees leaving and joining. *Vine*.
2. Aithal, P. S., & Aithal, S. (2020). Analysis of the Indian National Education Policy 2020 towards achieving its objectives. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *5*(2), 19-41.

3. Arcury, T. A., & Christianson, E. H. (1993). Rural-urban differences in environmental knowledge and actions. *The Journal of Environmental Education*, *25*(1), 19-25.
4. Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. *Child development*, *64*(3), 801-814.
5. Anderson, M. C., & Spellman, B. A. (1995). On the status of inhibitory mechanisms in cognition: memory retrieval as a model case. *Psychological review*, *102*(1), 68.
6. Batra, P. (2005). Voice and agency of teachers: Missing link in national curriculum framework 2005. *Economic and Political Weekly*, 4347-4356.
7. Chianson, M. M., Kurumeh, M. S., & Obida, J. A. (2010). Effect of cooperative learning strategy on students' retention in circle geometry in secondary schools in Benue State, Nigeria. *American Journal of Scientific and Industrial Research*, *2*(1), 33-36.
8. Child, J., Duarte, R. G., Tanure, B., & Rodrigues, S. B. (2012). Access to tacit knowledge by executive retention in cross-border acquisitions. *BAR-Brazilian Administration Review*, *9*(3), 329-350.
9. Custers, E. J. (2010). Long-term retention of basic science knowledge: a review study. *Advances in Health Sciences Education*, *15*(1), 109-128.
10. D'Antoni AV, Pinto Zipp G: Applications of the mind map learning technique in chiropractic education: A pilot study and literature review. Journal of Chiropractic Humanities. 2006, 13: 2-11.
11. Dewi, A. K., St Y, S., Surya, A., & Syawaludin, A. (2020, March). Thailand elementary school students' critical thinking skills in mathematics education. In *Journal of Physics: Conference Series* (Vol. 1511, No. 1, p. 012047). IOP Publishing.
12. Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public interest*, *14*(1), 4-58.
13. Duman, B. (2006, July). The effect of brain-based instruction to improve on students' academic achievement in social studies instruction. In *9th International Conference on Engineering Education, San Juan, Puerto Rico*.
14. Edo, B. L., & Nwosu, I. C. (2018). Working environment and teachers' productivity in secondary

schools in Port-Harcourt Metropolis. In *International* (pp. 39-49).

15. Elder, L., & Paul, R. (2010). Critical Thinking: Competency Standards Essential for the Cultivation of Intellectual Skills, Part 1. *Journal of Developmental Education*, *34*(2), 38- 39.
16. Ennis, R. H. (1962). A concept of critical thinking. *Harvard educational review*.
17. GAL, I. A., VLADAREANU, L., CIUPITU, L., MUNTEANU, M. S., BARBU, V., & FLOREA, G. F. (2016). COMPARATIVE ANALYSIS OF TOOLS FOR NAO ROBOT DYNAMICS SIMULATION WITHIN THE VIPRO PLATFORM. *Acta Electrotehnica*, *57*.
18. Furman, O., Dorfman, N., Hasson, U., Davachi, L., & Dudai, Y. (2007). They saw a movie: long-term memory for an extended audiovisual narrative. *Learning & memory*, *14*(6), 457- 467.
19. Gopal, G., & Anand, V. (2005). Environmental Education in school an overall perspective of NCF 2005-A resume.
20. Henson, R. K., & Thompson, B. (2001). Characterizing Measurement Error in Test Scores across Studies: A Tutorial on Conducting" Reliability Generalization" Analyses.
21. Hileman, S. (2006). Motivating students using brain-based teaching strategies. *Agricultural Education Magazine*, *78*(4), 18.
22. Howe, M. L., & Brainerd, C. J. (1989). Development of children's long-term retention. *Developmental Review*, *9*(4), 301-340.
23. Johnson, D. W., Johnson, R. T., & Stanne, M. B. (2000). Cooperative learning methods: A meta-analysis.
24. Kara, I. (2008). The effect on retention of computer assisted instruction in science education. *Journal of instructional Psychology*, *35*(4), 357-365.
25. Mayer, R. E. (2003). Elements of a science of e-learning. *Journal of educational computing research*, *29*(3), 297-313.
26. Lenin, I. (2019) Critical Thinking and its Importance in Education.
27. McMillan, J. H. (1987). Enhancing college students' critical thinking: A review of studies. *Research in higher education*, *26*(1), 3-29.
28. Mehra, V., & Thakur, K. (2008). Effect of cooperative learning on achievement and retention in mathematics of seventh graders with different cognitive styles. *Indian Educational Review*, *44*(1),

5-31.

29. Mangal, S. K., & Mangal, S. (2013). *Research methodology in behavioural sciences*. PHI Learning Pvt. Ltd.
30. Meyers, N. M., & Nulty, D. D. (2009). How to use (five) curriculum design principles to align authentic learning environments, assessment, students' approaches to thinking and learning outcomes. *Assessment & Evaluation in Higher Education*, *34*(5), 565-577.
31. Maknun, J. (2020). Implementation of Guided Inquiry Learning Model to Improve Understanding Physics Concepts and Critical Thinking Skill of Vocational High School Students. *International Education Studies*, *13*(6), 117-130.
32. National Education Policy (July, 2020). (Report) Ministry of Human Resource Development. gov. of India.
33. Oded, I., & Oded, Y. (2019, March). How to Assess Learning with Brain in Mind? In *Society for Information Technology & Teacher Education International Conference* (pp. 1362-1366). Association for the Advancement of Computing in Education (AACE)
34. Ozden, M., & Gultekin, M. (2008). The effects of brain-based learning on academic achievement and retention of knowledge in science course. *The Electronic Journal for Research in Science & Mathematics Education*.
35. Pratham, P. (2010). *Annual Status of Education Report (Rural) 2009 (Provisional)* (No. id: 2373).
36. Russak, H. M. (2001). *Annual Site Environmental Report, 2000 (ASER)* (No. SLAC-R- 572). SLAC National Accelerator Lab., Menlo Park, CA (United States).
37. Salam, J. (2019). Draft National Education Policy (NEP), 2019 and jingoistic nationalism.
38. Seabrook, R., Brown, G. D., & Solity, J. E. (2005). Distributed and massed practice: From laboratory to classroom. *Applied cognitive psychology*, *19*(1), 107-122.
39. Shields, G. S., Sazma, M. A., McCullough, A. M., & Yonelinas, A. P. (2017). The effects of acute stress on episodic memory: A meta-analysis and integrative review. *Psychological bulletin*, *143*(6), 636.
40. Sridhar, M. K., & Singai, C. NATIONAL EDUCATIONAL POLICY-2020: A Mandate for

Quality Higher Education in India.

41. Stanchev, L. (2008). Improving Knowledge Retention in a Technical Subject by Diversifying the Learning Experience. *International Journal of Learning*, *15*(6).
42. Syawaludin, A., & Rintayati, P. (2019). Development of Augmented Reality-Based Interactive Multimedia to Improve Critical Thinking Skills in Science Learning. *International Journal of Instruction*, *12*(4), 331-344.
43. Tran, V. D. (2014). The effects of cooperative learning on the academic achievement and knowledge retention. *International journal of higher education*, *3*(2), 131-140.
44. Watson, G. (1980). *Watson-Glaser critical thinking appraisal*. San Antonio, TX: Psychological Corporation.